in its axis, moves radially over a disk upon which is the graduation. The disk can be turned through a small arc for the adjustment of the zero. The instruments are very compact, simple, and strong, and very convenient in use; but the spring seems somewhat more likely to change than the simple spiral used by Kohlrausch.

Instead of the spring, Hopkins has proposed to use mercury confined in a capsule, the bottom of which is formed by an elastic diaphragm, upon which the iron core exerts a pull when the current passes. The capsule is filled with mercury, as is also a portion of a vertical glass tube inserted into it. The stress exerted upon the bottom of the capsule causes the mercury to fall in the tube, which may be provided with a scale, indicating current strength in the customary units. Various forms of apparatus recently described, involve the same or similar principles, using an iron rod floating in a cylinder partly filled with mercury, and an index-tube in which the mercury moves as displaced by the iron core, or having in the index-tube a lighter liquid for the purpose of increasing the range.

An entirely novel device has been employed by Lippmann. A horizontal tube, bent upward at the two ends, and partially filled with mercury, is placed between the poles of a strong magnet. By means of conducting-wires, the current is conveyed through the mercury in a vertical direction, at a point in the space between the poles of the magnet. The mercury, traversed by the current under the action of the magnet, is subject to a force which tends to move it laterally, thus changing the level in the two vertical arms, by an amount which is proportional to the intensity of the current. As the sensibility requires that the quicksilver column where traversed by the current should be very thin, this portion of the tube is given the form of a flat chamber only a fraction of a millimetre in thickness. If used for strong currents, the heating of the mercury would take place rapidly, and cause serious inconvenience. To avoid this would necessitate making the apparatus in much larger dimensions, with a loss of sensitiveness, or shortened range.

The rotation of the plane of polarization of a ray of light under the influence of an electrical current has been proposed as a means of measuring the current. Experiments, by a number of physicists, have shown that measurements may be made with considerable accuracy in this way; but as they all depend upon the determination of a plane of polarization, the device is found to be less convenient in its application than other methods.

We may notice in passing Cardew's volt-metre, in which the current is measured by the extension of a wire heated by it, an idea, which, though not new, has been applied to form a practical and useful instrument.

In all the instruments in which the current to be measured produces motion of a needle, or of a portion of the circuit, the action of external magnetic forces, whether of the earth, or of the machinery and circuits, as has already been noted, would be felt as soon as the sensitiveness of the instrument is pushed to the point required for great accuracy, and would make special provisions and precautions necessary. The spring instruments, as they utilize not the directive, but the attractive or repulsive action of the circuit, are almost entirely free from such disturbance, and are therefore better suited for those cases where time cannot be given to preliminary experiments for adjustment, and the determination of constants, or where it is desired to follow the changes of a rapidly varying current. It must be noted, moreever, as has been recently pointed out by Hospitalier, that where the changes in the current occur too rapidly, and especially in the case of intermittent or alternating currents, the self-induction in the coils of these instruments may give rise to considerable errors in their indications; and also that in all those cases where the effect to be measured depends upon the square of the current strength, instruments acting upon the principle of the dynamometer must be used to obtain trustworthy results.

ARTHUR W. WRIGHT.

INCANDESCENT LAMPS ON RAILWAYS.

FOR several months past, the Pennsylvania railroad company have been lighting nine of their cars with incandescent electric lamps. The electricity is produced by Brush storage batteries, which are charged once a week. The storage battery is carried underneath the cars in boxes built to receive them, — one-half being placed on each side. Each car requires six trays of four cells each. The trays are made so that the simple process of putting the trays in position completes the electric circuit. The battery when charged has an electro-motive force of forty-five volts; and, when the electro-motive force has fallen to thirty-nine volts, the battery is recharged. The batteries are charged at the depot in Jersey City by a sixteen-light Brush machine. In charging, the ordinary Brush manipulator, without the register, is employed.

Swan lamps consuming 1.1 ampères have been used almost exclusively, although Stanley-Thomson's lamps have been tried. The parlor-cars require ten sixteen-candle-power lamps, while the passenger-cars require but six. The lamps are all in parallel circuit, and so arranged that one-half may be used at a time. The wires are led through a clock mechanism, which registers the time they have been used. By an ingenious mechanical device, the clock is made to move half as fast when the switch throwing off half the lamps is turned.

Altogether, some seventeen batteries, of twenty-four cells each, are in use; and, as yet, only one cell has been disabled. As to loss of efficiency, due to deterioration, no tests have been made. Although the lamps are probably much less than sixteen-candle power, it is probable that their life is less than that of those used in buildings, because of the jarring to which they are subjected.

It is claimed that the cost of lighting the cars by the incandescent lamp compares favorably with that of lighting by compressed gas. During the heavy storms which prevailed during the first week of August, forty-eight cells of these storage batteries did the work on a telegraph-line which five hundred gravity-cells failed to accomplish.

CHLOROFORM AS AN ANAESTHETIC.

Experiments have shown that the vapor of thirty grams of chloroform, mixed with a hundred litres of air, will kill a dog in a few minutes; while a dose three times as strong, if diluted with a cubic metre of air, produces a sleep without danger, lasting two hours. The tension of the vapor, rather than the quantity, determines the effect; but the operator, in administering the anaesthetic, has to take into account the quantity: so that, under apparently the same conditions, very different results are obtained; and hence arises the difference of opinion among surgeons as to its use. Six grams in a hundred litres of air have very little effect upon a dog; ten grams produce insensibility for an hour and a half; while fourteen grams cause death in forty-five minutes, and twenty grams in five minutes. In the case of man, with an inspiration of half a litre, these results are produced by three, five, seven, and ten centigrams of chloroform respectively. It will be seen that the difference between the harmless and the dangerous proportions is very slight. Accordingly, the use of chloroform has always been considered dangerous; and, in order to make it less so, Mr. Paul Bert has made experiments upon animals, and afterwards applied them to man. His experiments with man have extended over two hundred cases, including patients of all kinds of temperaments, with always the same result. He uses ten grams of chloroform vaporized in a hundred litres of air, — a dose agreeable to some, and to none disagreeable. The most disagreeable effects of the anaesthetic have always been felt in the period of repulsion; but Mr. Bert almost entirely removes this. The period of excitement is not great, and only lasts from one to two minutes; while in the case of more than one-third of the adults it is entirely absent. The pulse is a little accelerated during the period of excitement, but remains perfectly normal and regular during sleep. Complete insensibility is produced in from six to eight minutes, and is maintained during the whole time of respiration. After the patient becomes insensible, the quantity of chloroform is reduced to eight grams, and later to six. Painful operations have no effect, except that the respiratory movements are slightly accelerated. There is no nauseation, and the amount of chloroform administered is not enough to cause poisoning; while there is no fear of asphyxia, for the amount of oxygen is reduced only by a hundredth. Indeed, with the exception of cerebral congestion and faintings, none of the ordinary dangers need be feared.

Condensed from *La nature*.

VAN ERMENGEM ON THE CHOLERA MICROBE.

Some months ago we spoke of Van Ermengem's results in investigating the cholera bacillus, and promised to refer to them again. His completed report, as presented to the Belgian minister of the interior, with additions in the way of notes and plates, makes a volume of some three hundred and sixty pages. As it is the most complete summary yet published of this much-vexed question — the relation of Koch's comma bacillus to cholera — we have thought it worth more than a passing notice. Commissioned by the government, Dr. Van Ermengem obtained material, and made observations upon the bacillus in Paris, Berlin, Marseilles, during the epidemic of the last year, and in his own laboratory at Brussels.

The report is divided into three sections, the first of which treats of his expedition to Paris, Berlin, and Marseilles, and the work which he did there; the second gives the results of his investigations; and in the third he discusses the consequences of this discovery of the comma bacillus.

First visiting Paris, the author saw Dr. Roux in Pasteur's laboratory, and obtained specimens from him, prepared under Koch's supervision at Toulon; from this place he went to Marseilles, where he was able to work with Nicati and Rietsch, and pursued his investigations until he was certain of the constant occurrence of the curved bacillus in Asiatic cholera, and until he had obtained sufficient material with which to pursue the study of the micro-organism in his own laboratory. To make doubly sure that he was working with the right thing, he went to Berlin, and showed his cultures and microscopic preparations to Koch himself.

The morphology of the cholera microbe is most exhaustively treated. Its curved shape is, of course, its most striking characteristic; and the author declares his belief that no other organism possessing all its peculiarities has been found. The method of preparation for the microscope is the usual one of Weigert Koch, and the organisms seem to have no special affinity for any coloring-material. Gram's method gives good results; and, in sections, the author prefers watery solutions of methylene blue, or methyl violet 5 B. Left in either of these solutions for from one to two

Recherches sur le microbe du choléra Asiatique. Rapport présenté à M. le ministre de l'intérieur le 3 novembre, 1884. Par le Dr. E. Van Ermengem, augmenté de nombreuses notes et orné de douze planches photographiques, reproduisant vingt-quatre microphotographies originales. Paris, *Bruxelles*, 1885. 8°.